

**CONFIDENTIAL**

APPLICATION FOR  
U.S. LETTERS PATENT  
FOR

**"METHODS OF PHOSPHOROUS REDUCTION  
IN STORMWATER RUNOFF SYSTEMS USING IRON HUMATE"**

INVENTOR: Larry MADRID  
175 East Summerlin Street  
Bartow, Florida 33830

ATTORNEY: GEORGE A. BODE  
REG. NO. 30,028  
BODE & ASSOCIATES, P.C.  
2314 Broadway  
New Orleans, Louisiana 70125-4128  
Telephone: (504) 861-8288  
Facsimile: (504) 866-6717

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**"METHODS OF PHOSPHOROUS REDUCTION IN STORMWATER RUNOFF SYSTEMS USING IRON HUMATE"**

**BACKGROUND OF THE INVENTION**

**1. Field of the Invention**

5        The present invention relates to treatment of runoff water from non-point sources and, more particularly, to a method of phosphorous reduction in stormwater runoff and groundwater systems using iron humate.

**2. General Background**

10       Iron humate is a co-product of certain municipal drinking water treatment systems. The material is an iron rich organic compound. It is produced by introducing ferric sulfate to river water as a flocculent to remove floating organic detritus.

15       Research has proven that excessively high levels of nitrogen and phosphorus have detrimental affects on water bodies, such as Lake Okeechobee, Lake Hancock, the Kissimee River and the Everglades. The State of Florida and the Federal Government are committing billions of 20 dollars to the improvement of water bodies by the reduction of phosphorus from runoff from non-point sources, such as dairy farms, sugar cane fields, and any other lands that use high doses of fertilizer over many years.

Several methods have been patented which are aimed at water treatments to remove nitrogen, phosphorous and other compounds.

U.S. Patent No. 5,766,474 issued to Landmark Reclamation, Inc., of Denver, Colorado, on the application of S.W. Smith, et al., entitled "BIOMASS IMPONDMENT MANAGEMENT SYSTEM FOR PURIFYING WATER," discloses a biomass system for purifying water runoff from ponds and lakes which includes an non-rooted plants and bottom dwelling plants in the impoundment to adsorb impurities, such as phosphorous, ammonia, nitrogen and heavy metals.

U.S. Patent No. 4,707,270 issued to Ube Industries, Ltd., of Japan, on the application of W. Kobayashi, et al., entitled "PROCESS FOR TREATING WASTE WATER CONTAINING PHOSPHORUS COMPOUNDS AND/OR ORGANIC COD SUBSTANCES," discloses a process for treating water using calcium silicate compounds as adsorbent agents to remove various phosphorous compounds.

U.S. Patent No. 6,036,851 issued to S.G. Simmering, et al., entitled "PEAT BALE FILTRATION ELEMENT," discloses treating stormwater runoff to remove phosphorous in a retention pond with a peat bale in a layered filtration bed.

U.S. Patent No. 6,042,743 issued to Environmental

Filtration, Inc., of Brooklyn Park, Minnesota, entitled "METHOD OF PROCESSING PEAT FOR USE IN CONTAMINATED WATER TREATMENT," discloses a method of processing peat for treating contaminated aqueous solutions.

5           U.S. Patent No. 5,322,629 issued to W & H Pacific, Inc., of Bellevue, Washington, on the application of W.C. Stewart, entitled "METHOD AND APPARATUS FOR TREATING STORM WATER," discloses an apparatus for treating stormwater runoff with humas-rich compost in beds as an 10 adsorbent to remove contaminants such as phosphorous from drain fields.

U.S. Patent Nos. 5,462,666 and 5,670,046 issued to RJJB & G, Inc., of West Palm Beach, Florida, on application of R. C. Kimmel, entitled "TREATMENT OF 15 NUTRIENT-RICH WATER," discloses a multistage treatment system which treats water having nitrogen compounds, phosphorous compounds, and other minerals. An insoluble salt is used to precipitate phosphorous compounds and other minerals wherein the precipitate is separated in a 20 separation device.

U.S. Patent No. 5,174,897 issued to The United States of Americas as represented by the Secretary of Agriculture, of Washington, D.C., on application of Wengrzynek, entitled "CONSTRUCTED WETLANDS TO CONTROL 25 NONPOINT SOURCE POLLUTION," discloses a construct of a

sediment basin, level-lip spreader, grassy filter, wetlands and a deep pond used to remove pollutants from nonpoint source runoff.

U.S. Patent Nos. 5,213,692, 5,302,180 and 5,411,569, 5 issued to Kemiron, Inc., of Bartown (Sic), Florida, on application of Hjersted, disclose an iron humate product and processes for preparing iron humates such as for vegetation and supplementation of animal feedstock.

U.S. Patent No. 5,354,350 issued to The Vigoro Corporation, of Chicago, Illinois, on application of Moore, discloses a citrate soluble slow release iron humate agricultural nutrient composition. 10

## SUMMARY OF THE PRESENT INVENTION

The preferred embodiment of the method of phosphorous reduction in stormwater runoff of the present invention solves the aforementioned problems in a 5 straight forward and simple manner.

Broadly, the present invention contemplates a method of phosphorous reduction in stormwater runoff using iron humate, such as in the form of a filter, a layered filter bed, a stacked wall or a liner.

10 More specifically, the method of phosphorous reduction in stormwater runoff of the present invention comprising the steps of: channeling a fluid runoff into a fluid retention area; filtering the fluid runoff through iron humate to absorbing phosphorous from the 15 fluid runoff with the iron humate to create filtered fluid runoff; and, discharging the filtered fluid runoff out of the fluid retention area.

20 Additionally, the present invention contemplates an iron humate filter comprising: a mesh cage housing having mesh cage walls; a geotextile fabric lining the mesh cage housing; and, iron humate enclosed in the mesh cage housing wherein fluid is adapted to flow through the mesh cage housing and the geotextile fabric to the iron humate

where phosphorous is absorbed or chemically retained.

The above and other objects of the present invention will become apparent from the drawings, the description given herein, and the appended claims.

**BRIEF DESCRIPTION OF THE DRAWING**

For a further understanding of the nature and objects of the present invention, reference should be had to the following description taken in conjunction with the accompanying drawings in which like parts are given like reference numerals and, wherein:

**FIGURE 1** illustrates an iron humate filter installation employing a retention pond to carrying out the method of the present invention;

10           **FIGURE 2** illustrates an iron humate filter installation employing a wetland reservoir to carrying out the method of the present invention;

15           **FIGURE 3** illustrates an iron humate filter installation employing a retention pond to carrying out the method of the present invention in combination with a turnkey treatment plant;

**FIGURE 4** illustrates an iron humate filter installation employing an agricultural ditch to carrying out the method of the present invention;

20           **FIGURE 5** illustrates a first embodiment of an iron humate filter of the present invention;

**FIGURE 6** illustrates an top plan view an iron humate filter assembly of the present invention;

**FIGURE 7** illustrates an second embodiment of an iron humate filter for use with the iron humate filter assembly of **FIGURE 6**;

**FIGURE 8** illustrates a side view of the iron humate filter assembly of **FIGURE 6**; and,

**FIGURE 9** illustrates a cross-sectional view along the PLANE 8 - 8 of the embodiment of **FIGURE 9**.

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## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

### OVERVIEW

The overall method of phosphorous reduction in stormwater runoff of the present invention uses barriers, 5 liners or structures of iron humate (FeHu), hereinafter referred to as iron humate filters submerged in an fluid retention area down stream of the stormwater runoff to absorb phosphorous from the stormwater runoff. In the exemplary embodiment, the stormwater runoff flows or is 10 channeled to the fluid retention area from non-point sources(e.g., dairy farms, sugar cane fields).

The fluid retention area may be a retention pond **40** or **240**, as best seen in **FIGURES 1** and **3**, wetland reservoir **140** with vegetation, as best seen in **FIGURE 2** 15 or an agricultural ditch **340**, as best seen in **FIGURE 4**.

Referring now to the iron humate filter, FeHu has a strong ability to adsorb (chemically retain) phosphorous. Hence, I have determined that with the problems of high 20 nitrogen and phosphorous levels in Florida's waters, a structure of FeHu, which allows stormwater runoff to flow

therethrough, chemically retains phosphorous found in the stormwater runoff. Thereby, the FeHu can be used to reduce phosphorous from non-point sources of stormwater runoff (e.g., dairy farms, sugar cane fields).

5 Since the FeHu chemically absorbs phosphorous or phosphorous compounds, the iron humate filter will become saturated. When the iron humate filter becomes saturated, the iron humate filter should be removed and replaced with another iron humate filter. As will be  
10 described in more detail below, alternately, the saturated iron humate in the iron humate filter may be replaceable with a clean or non-saturated iron humate instead of removing the filter.

**EXAMPLE 1**

15 Referring now to **FIGURE 1**, the method of phosphorous reduction in a stormwater runoff, is best seen in **FIGURE 1**, where a iron humate filter installation **20** is employed downstream of a dairy farm or other non-point stormwater runoff source **30**. The iron humate filter installation **20**  
20 includes a retention pond **40** which is positioned to down

stream the surface stormwater runoff flow **ARROW 50** and slows the surface stormwater runoff flow **ARROW 50** down. The stormwater runoff filters through the iron humate filter **60**. The iron humate filter installation **20** 5 further includes a retention pond drain pipe **80** which discharges or channels filtered stormwater runoff into a control ditch **70** on the output side of the iron humate filter **60**. The filtered stormwater runoff in the control ditch **70** has a significantly lower level of phosphorous. 10 Thereafter, the fluid solution in the control ditch **70** can then be funneled to other water ways or used appropriately.

Eventually, the iron humate in the iron humate filter **60** will reach "breakthrough" or a phosphorous 15 saturation stage - a stage where it cannot retain any more phosphorous - and a fresh iron humate filter **60** would be needed. The saturated or phosphorous-laden FeHu could then be sold or processed into fertilizer.

#### EXAMPLE 2

20 Referring now to **FIGURE 2**, an alternate embodiment

for carrying out the method of the present invention that includes iron humate filter installation **120** downstream of a non-point stormwater runoff source **30** (**FIGURE 1**) is shown. The iron humate filter installation **120** includes 5 a wetland reservoir **140** which is positioned to slow down surface stormwater runoff flow **ARROW 50** into the wetland reservoir **140**. The wetland reservoir **140** is lined, including its perimeter sides **142** and bottom floor **145**, with a iron humate filter liner **160** which filters the 10 stormwater runoff flow **ARROW 50**.

As is well known, FeHu, a known fertilizer, provides iron and other nutrients for vegetation. Thus, the iron humate filter liner **160** promotes vegetation growth **147** in the wetland reservoir **140** while also absorbing 15 phosphorous, thereby also promoting further phosphorous reduction by plant uptake.

The iron humate filter liner **160** further includes iron humate filter mounds **165** spaced along the iron humate filter liner **162**. The discharge from the wetland 20 reservoir **140** is sent downstream to control ditch **70**.

As described above, eventually, the iron humate will reach "breakthrough" or a phosphorous saturation stage - a stage where it cannot retain any more phosphorous - and a fresh iron humate or iron humate 5 filter liner 160 and mounds 165 would be needed.

EXAMPLE 3

Referring now to **FIGURE 3**, an iron humate filter installation 220 employing a retention pond 240 to carrying out the method of the present invention in 10 combination with a turnkey treatment plant FeHu system 210 is shown. The iron humate filter installation 220 includes an upstream retention pond 240, pump 245 and an iron humate-packed filter 260. The surface stormwater runoff flow **ARROW 50** flows down to the upstream retention 15 pond 240, where the stormwater runoff is pumped under pressure through pump 245 to the iron humate-packed filter 260. The discharge of the iron humate-packed filter 260 on outlet port 264 is channeled downstream to control ditch 70.

EXAMPLE 4

Referring now to **FIGURE 4**, an iron humate filter installation **320** employing an agricultural ditch **340** to carrying out the method of the present invention is shown. The agricultural ditch **340** has an aqueous solution flow **ARROW 350a** and agricultural surface runoff flow **ARROWS 350b** and **350b'**. Downstream from the aqueous solution flow **ARROW 350a** and the agricultural surface runoff flow **ARROWS 350b** and **350b'**, iron humate filters **360** are stacked and positioned across the width of agricultural ditch **340** to create a filtering wall **325**. In the exemplary embodiment, there are two walls **325** and **327** adjacent to each other at approximately 500 feet - 1000 feet spacing. The discharge from the second wall **327** can be sent downstream to control ditch **370** which flows into a natural creek, stream or river in the direction of **ARROW 350c**.

Referring now to **FIGURE 5**, a iron humate filter **360** is shown. The iron humate filter **360** includes in general

a basket or cage housing 380 made of mesh which is adapted to be filled with iron humate 365. In the exemplary embodiment, the basket or cage housing 380 includes a lid or cover 385 also preferably made of mesh to permit the flow of stormwater runoff to flow therethrough. The lid or cover 385 allows the saturated iron humate 365 to be removed from time-to-time and processed remotely or, alternately, sold. The basket or cage housing 380 is lined with a geotextile fabric 385 with a permittivity of about 100 - about 200 gal/SF/min, or, as designed hydraulically to allow water to flow through the system, geotextile fabric 385 holding iron humate 365 inside of cage housing 380 and allowing water to pass therethrough.

In the exemplary embodiment, the basket or cage housing 380 includes a mesh opening of 3" x 3" (7.5 cm. x 7.5 cm) with a mesh wire of 0.106 - US gauge 12 (2.7 mm). The mesh is PVC coated with a minimum thickness of 0.0150" per side and a nominal thickness of 0.0216" per side.

The length **L** of the basket or cage housing **380** is approximately 6 feet, the width **W** is approximately 3 feet, the height **H** is approximately 3 feet. However, the basket or cage housing **370** can have any number of cells or compartments for the placement of the iron humate **365**.  
5 The compartments are created by the baffle walls also made of mesh.

As can be appreciated, the iron humate filter **60** and a iron humate filter liner **160** with mounds **165** are  
10 created filters similar to the iron humate filter **360** but may vary with size. Iron humate filter **260** differs from the submerged iron humate filters **20**, **160**, and **360** and requires a closed housing for maintaining the fluid pumped therethrough. Furthermore, the iron humate filter  
15 **260** requires inlet and outlet ports **262** and **264**.

Referring now to **FIGURES 6 - 9**, an iron humate filter assembly **400** is shown. Iron humate filter assembly **400** fits into a half-round spillway or L-shaped conduit **420** typically constructed of corrugated metal

pipe and widely commercially available. Assembly 400 includes a riser frame 410 with a plurality of cross brace angles 415 supporting an upright tubular channel 422 of L-shaped conduit 420. The tubular channel 422 has 5 a closed bottom 425 and intersects perpendicularly with horizontal tubular channel 427. In the exemplary embodiment, the horizontal tubular channel 427 is semi-circular shaped so that the bottom half can lay on the ground or other horizontal surface.

10 The iron humate filter assembly 400 further includes an iron humate filter 450 which fits in the bottom of the upright tubular channel 422 wherein stormwater runoff flows down the tubular channel 422 through the iron humate filter 450 to horizontal tubular channel 427. The 15 iron humate filter 450 includes a smaller basket or cage housing 480 made of expanded metal mesh which is adapted to be lined with a geotextile fabric 485 and filled iron humate. The geotextile fabric 485 assists in maintaining the iron humate in the basket or cage housing 480. The

basket or cage housing **480** includes a top handle **488** to permit the removal of the iron humate filter **450** and may include a rigid metal frame **482** supporting walls of an expanded metal cage **484**.

5         Iron humate filter assembly **400** may further include a steel or aluminum grate **490** positioned at the top of the vertical tubular channel **420**.

10         In an alternate usage or method of deployment, iron humate filters wrapped in geotextile filter fabrics can be fitted inside manholes and other types of stormwater inlets to filter runoff from urban areas, such as streets, parking lots and grassed swales.

15         Further, flow rates through iron humate may be increased by adding pine bark, rocks or other materials that are more permeable than the iron humate. The specific ratio for a iron humate-pine bark mixture will by necessity be site specific.

20         Because many varying and differing embodiments may be made within the scope of the inventive concept herein taught and because many modifications may be made in the embodiment herein detailed in accordance with the

descriptive requirement of the law, it is to be understood that the details herein are to be interpreted as illustrative and not in a limiting sense.

What is claimed as invention is: